

WHAT IS CLAIMED IS:

1. A vehicle antenna apparatus capable of corresponding to a plurality of radio communication systems, comprising:

5 a plurality of antennas provided correspondingly to the radio communication systems;

10 a plurality of processing circuits whose one ends (input ports or output ports) are connected to the antennas to apply processings including amplification and frequency conversion to signals input from the one ends of the antennas received from a corresponding antenna or signals to be transmitted to a corresponding antenna input to the other ends of the antennas;

15 at least one external connector configured to output reception signals to an external unit or inputs transmission signals sent from the external unit; and

20 a unit connected between the other ends of the processing circuits and the external connector to couple reception signals output from the processing circuits or distribute transmission signals input from the external connector to the processing circuits.

2. A vehicle antenna apparatus capable of corresponding to a plurality of radio communication systems, comprising:

25 a plurality of receiving antennas provided correspondingly to the radio communication systems to receive radio waves transmitted from an external unit

and to output reception signals;

a plurality of receiving frequency converters configured to frequency-convert reception signals sent from the receiving antennas;

5 a coupler configured to couple signals output from the receiving frequency converters and to output one output signal; and

at least one external connector connected with an external unit to transfer signals output from the coupler to the external unit.

3. A vehicle antenna apparatus capable of corresponding to a plurality of radio communication systems, comprising:

15 a plurality of receiving antennas provided correspondingly to the radio communication systems to receive radio waves transmitted from an external unit and to output reception signals;

a plurality of receiving frequency converters configured to frequency-convert signals received from the antennas;

20 a coupler configured to couple signals output from the receiving frequency converters and to output one output signal;

25 at least one external connector connected with an external unit to transfer signals output from the coupler to the external unit;

at least one transmitting frequency converter

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configured to frequency-convert transmission signals  
input to the external connector from an external unit;  
and

5           at least one transmitting antenna provided  
correspondingly to at least one radio communication  
system to receive signals output from the transmitting  
frequency converter and to radiate radio waves.

4. The vehicle antenna apparatus according to  
claim 2, wherein the plurality of receiving frequency  
10       converters convert signals received from the plurality  
of receiving antennas into proximate frequencies.

5. The vehicle communication system according  
to claim 3, wherein the external connector includes  
one input/output terminal and moreover includes a  
15       separation element inserted between the input/output  
terminal, the output end of the coupler, and the input  
ends of the transmitting frequency converters to  
separate transmission signals from reception signals.

6. The vehicle antenna apparatus according to  
20       claim 3, wherein the external connector includes  
an output terminal and an input terminal, transfers  
signals output from the coupler to the external unit  
through the output terminal, and inputs signals  
transmitted from the external unit to the input  
25       terminal.

7. The vehicle antenna apparatus according to  
claim 3, further comprising a distributor configured to

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distribute transmission signals input to the external connector from said external unit to the transmitting frequency converters.

5       8. The vehicle antenna apparatus according to claim 3, wherein at least one of the receiving antennas and at least one of the transmitting antennas are used in common.

10       9. The vehicle antenna apparatus according to claim 2, further comprising an A/D converter configured to convert signals output from the coupler into digital signals and supplies the digital signals to the external connector.

15       10. The vehicle antenna apparatus according to claim 2, further comprising a plurality of A/D converters configured to convert signals output from the receiving frequency converters into digital signals and supply the digital signals to the coupler, wherein the coupler couples digital signals output from the A/D converters through parallel-serial conversion and  
20       synthesizes them into one signal.

25       11. The vehicle antenna apparatus according to claim 3, further comprising a D/A converter configured to convert a transmission signal input from the external connector as a digital signal into an analog signal and supplies the analog signal to the transmitting frequency converters.

12. The vehicle antenna apparatus according to

claim 2, further comprising an E/O converter configured to convert a signal output from the coupler into an optical signal and supplies the optical signal to the external connector.

5           13. The vehicle antenna apparatus according to claim 2, further comprising a plurality of E/O converters which convert signals output from the receiving frequency converters into optical signals and supply them to the coupler, wherein the coupler couples  
10           optical signals output from the E/O converters and synthesizes them into one optical signal.

          14. The vehicle antenna apparatus according to claim 3, further comprising an O/E converter which converts a transmission signal input from the external  
15           connector as an optical signal into an electrical signal and supplies the electrical signal to the transmitting frequency converters.

          15. The vehicle antenna apparatus according to claim 1, wherein at least one of the antennas is  
20           an array antenna and a beam-forming network for forming an optional antenna beam through the array antenna is included.

          16. The vehicle antenna apparatus according to claim 15, further comprising a CPU which controls the  
25           beam-forming network.

          17. The vehicle antenna apparatus according to claim 1, wherein at least one of the antennas is

an array antenna, and a beam-forming network which forms an optional antenna beam through the array antenna and a CPU which controls the beam-forming network and the processing circuits are included.

5           18. The vehicle antenna apparatus according to claim 16, further comprising a memory storing the information for the above control by the CPU.

10           19. The vehicle antenna apparatus according to claim 1, wherein the antennas are provided on the same first substrate.

15           20. The vehicle antenna apparatus according to claim 1, wherein the antennas are provided on the same first substrate and the processing circuits and a unit which performs the above coupling or distribute are provided on the first substrate or a second substrate different from the first substrate.

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